

A scrutiny of the introduction

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Abstract

The introduction to a technical paper should be an invitation to readers to invest their time reading it. Typically this invitation has three parts (1) the review, (2) the claim, and (3) the agenda. In the *claim*, the author should say why the paper's *agenda* is a worthwhile extension of its historical *review*. Personal pronouns should be used in the claim and anywhere else the author expresses judgment, opinion, or choice.

Introduction

Throughout the years, I have participated in reading committees of more than a hundred doctoral dissertations. Additionally, reports of the Stanford Exploration Project contain about 60 papers a year, and I am nominally in charge of making them presentable. In all this activity, I have seen many poor abstracts and, in each case, I have spared myself and the author much struggle by referring to the short paper *A scrutiny of the abstract* by Kenneth Landes (*AAPG Bulletin* 1966, 1990), which was formerly distributed by the SEG to all its aspiring authors. I rarely rewrite authors' abstracts any more—it's usually enough to have them read Landes' paper and rewrite it themselves. Landes' own abstract is worth quoting:

The abstract is of the utmost importance, for it is read by 10 to 100 times more people than hear or read the entire article. It should not be a mere recital of subjects covered. Expressions such as "is discussed" and "is described" should *never* be included. The abstract should be a condensation and concentration of the *essential information* in the paper.

Introductions are not easy to write either. I am pleased to report that in recent years, I have developed a formula for the introduction. With this paper expounding my formula, I am hoping to reduce the need for one-on-one tutoring. You might be able to produce a good introduction without following my formula but if you have trouble producing one *that pleases other people* (and you would like to finish it and get on with your life), then I suggest you follow my formula.

First, I describe the three essential parts of an introduction and

then I offer some tips on overall organization. You will see why introductions are so difficult to write once you understand how introductions depend on that most embarrassing of all words, "I."

The body of an introduction

My formula for an introduction is a sequence of three parts. They are (1) the review, (2) the claim, and (3) the agenda.

The review. Pick out about 3-10 papers providing a background to your research and say something about each of them. You could paraphrase a sentence or two from each abstract. The review is not intended to be a *historical* review going back to Newton or Descartes. Try to find a few papers by your office mates, your advisor, your predecessors, or other associates. That way you might find somebody to give you helpful criticism!

Anyone can follow these instructions and write a review that *looks* presentable. Where intelligence and skill are required is in organizing the review so that it leads up to something, namely your *claim*.

The claim. The most important part of the introduction is buried in the middle. It is the *claim*. The claim is where you claim your work is a worthwhile extension of the review you just wrote. If someone says your writing is "unmotivated," they aren't insulting your humanity, it just means they can't find your claim.

In your claim, you should use the personal pronoun "I" (or "we" if you aren't the sole author). The word "I" tells people where common knowledge runs out and your ideas begin. If you are writing a doctoral dissertation or an article for a refereed journal, then you should be making a new contribution to existing knowledge. Your paper is *not acceptable* without an identifiable claim.

Whether your ideas are solid as bedrock or speculative as clouds, you need first-person pronouns. Where your ideas are speculative, the pronouns signal a disclaimer. Where your ideas are solid, the pronouns signal that *you* may be credited for them. When your friends see your personal pronouns, they will know just where they should offer their questions and suggestions.

You may use personal pronouns elsewhere in your paper, too. Generally, you should use a personal pronoun whenever you are *expressing an opinion* or *exercising judgment*. Another time to use "I" is whenever there is a simple matter of *choice*. For example, "To test the theory, I selected some data," or "To examine the theory, I programmed the equations," or "To evaluate the hypothesis, I made some synthetic seismograms."

Good scientific papers contain many types of statements ranging from ancient axioms to common knowledge to speculations

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due to the association with nonpetroleum exploration research in the Department of Automation, some institute students appear preoccupied with application of artificial intelligence and pattern recognition to seismic structural and stratigraphic interpretation. Other research subjects are trace inversion (pseudoacoustic impedance logs), automation of reflection velocity analyses and derivation of interval velocity-depth functions, raytracing in heterogeneous media, automatic inversion of refraction time-distance data for reflection static time corrections, and deconvolution. The institute is a source of professional employees for the BCC and GRI. It is supported by the CNOGEDC and, accordingly, GRI computer systems and processes are available for institute research.

I also had the opportunity to visit the Acoustic Laboratory in the Department of Physics, at the invitation of its director, Professor Zhu Guozhen. Research projects at the laboratory include acoustic logging in porous media, reflection and refraction of acoustic waves at interfaces, simultaneous determination of viscosity and density by acoustic waves, neural network methods for tracing seismic events, and determina-

tion of acoustic impedance from seismograms. Some other research projects, not related to petroleum exploration, are measurements of flexoelectric coefficients in nematic liquid crystals by an acoustic method, electromechanical feedback systems, and an ultrasonic welder for on-line metal-oxide semiconductor production. Professor Zhu is acquainted with research directed by Amos Nur at Stanford University and, in fact, one of his students is presently in Professor Nur's group.

The Chinese government is strongly encouraging foreign investment and ventures in China, and the importation of experts. The economy remains depressed following the tragic Tiananmen Square affair of 1989. The government is hopeful that the 11th Asian Games, held September 22-October 7, 1990 in Beijing, will stimulate tourism and the economy. Preparations and advertisements were extensive. As one promotion, the Games' organizing committee invited all foreign experts and spouses in Beijing to tour newly constructed Games facilities on one afternoon. My wife and I were privileged to be included. Principal structures are two large olympic-style buildings (one for indoor games and one

for aquatic sports) and an outdoor stadium (largest in China) for field events. A total of 27 medal events were scheduled in field and track, swimming, water polo, handball, and tennis. More than 6000 athletes were expected from 39 member nations of the Asian Olympic Council. Attendance was expected to exceed one million. Because of these facilities, the Games management plans to bid for the 2000 Olympic Games. **LE**



S. Norman Domenico earned a doctorate in geophysics from the Colorado School of Mines in 1951. He was employed by Amoco for more than 30 years and served as chief geophysicist and geophysical research manager. Domenico received SEG's Kauffman Gold Medal in 1981 for his pioneering research concerning the bright spot phenomenon. He was awarded SEG Honorary Membership in 1986.

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and outright guesses. It is the *writer's* fault if a casual reader cannot distinguish these types of statements. Personal pronouns are good words to keep the distinctions clear. Other good words for this purpose are "should, could, would, might, may, can, is, does..." Use them all and pick the best for each purpose.

Some editors of scientific papers mechanically introduce the personal pronoun "I" to avoid the passive voice. I don't agree with them. For example, such editors will change "Substitution of equation (1) into equation (2) gives..." into "Substituting equation (1) into equation (2), I find..." The first wording states a simple fact but the second wording hints that someone else might get a different result.

The agenda. An agenda is found at the end of many introductions. It summarizes what you will show the reader as your paper progresses. Your agenda will be dull if it is merely a recital of the topics you will cover. Instead, it should tell how your paper works to fulfill your claim. In this way, your agenda should clarify your claim.

The agenda is not as important as the review and the claim. Keep it short.

Occasionally, you will be fortunate enough to be writing about something in which some of your conclusions can be made in simple statements. If so, state them early, right after your agenda. You aren't trying to write a mystery! Many more people will *begin* reading your paper than will *finish* reading it. Motivate them to finish! Unfortunately, many technical papers do not lend themselves to early conclusions.

After the introduction

Of course, you want people to read beyond your introduction, too. So think carefully about the order of your material and how you say things. (Notice this tiny paragraph is a small abstract of what follows.)

Order of material. You could write your paper so that each part builds on earlier parts. Like the axiomatic approach to geometry, you could refuse to refer to things not yet proven. But, rather than write your paper that way, it is wiser to maximize your readership. Since many more people will begin your paper than will plow through all the way to the end, try to state results before you prove them. Put off complicated derivations and digressions until the end. Complicated mathematical derivations, especially if marginal to your main thesis, should be relegated to appendices.

What is central and what is peripheral? In your paper, you might want to include digressions, possible applications, etc. That's nice. But be sure to include language that labels them as peripheral. If you don't, you may find people (and not just critics and enemies) missing your main point.

Conclusion

This short article is not a typical technical paper, but you might like to look back at the introduction to see if I follow my own advice. **LE**